Chapter 5
Work and Energy

Work

Section 5-1 page 160

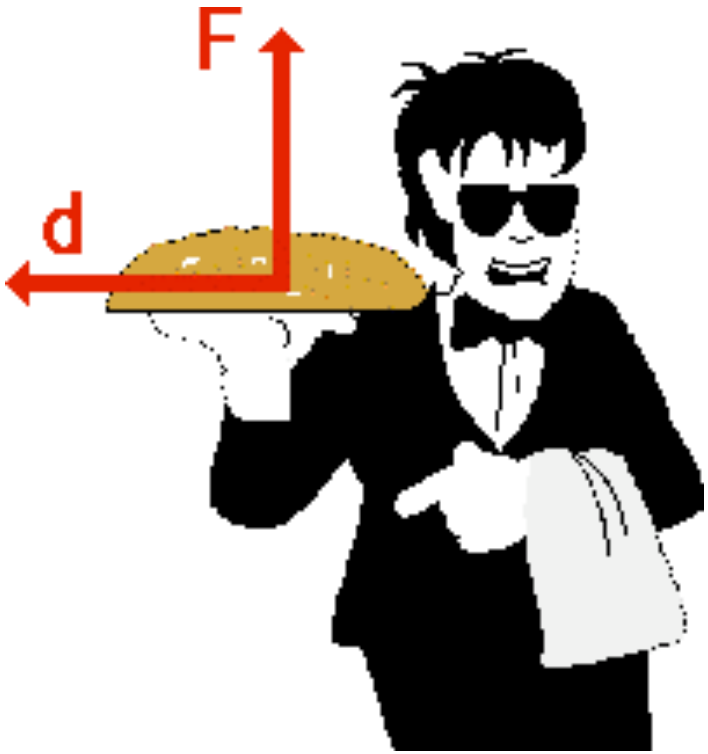
Define work done on an object by a force as

(Work) = (Force) X (Displacement)

Force acting in direction of motion: Positive work.
Force acting in opposite direction: Negative work.
Force perpendicular to motion: Zero work

Is any work being done on the food as the waiter carries it?

No! The force is perpendicular to the displacement!

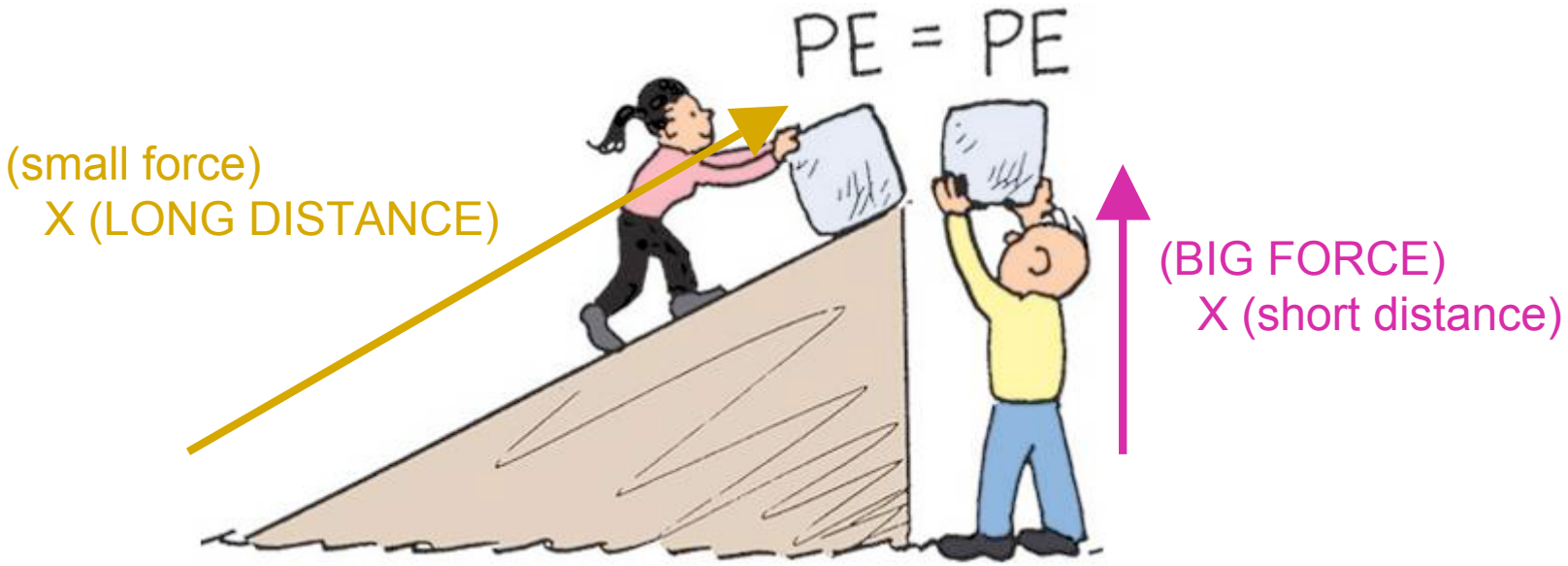


Vector or Scalar

- Since work is calculated by multiplying a force (vector) by displacement (vector), it becomes a scalar
- A vector quantity multiplied or divided by a vector quantity makes a scalar quantity
- Since work is a scalar, you don't need to worry about direction, only whether it's positive or negative

Work & Energy

When forces do work on an object, the work done equals the change in energy.



Two persons do the same work in different ways.

Sample Problem

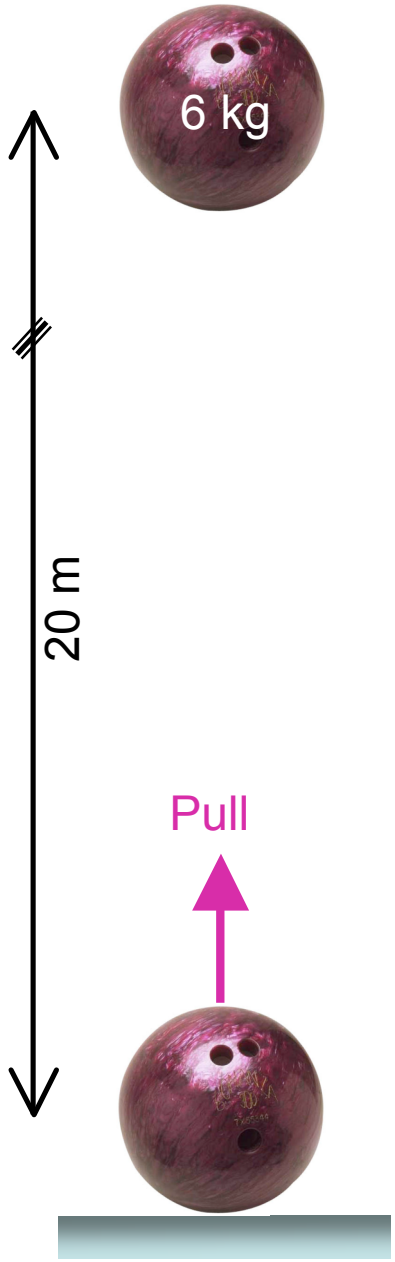
How much work do you do in lifting a 6 kg bowling ball a distance of 20 meters by pulling up with a force equal to its weight?

Since weight is 60 Newtons, work done on the ball is

(Work) = (Force) x (Distance)

= (60 N) x (20 m)

= 1200 Joules



Work units!

- The units used to measure work are Joules
- 1 Joule (J) = 1 N-m

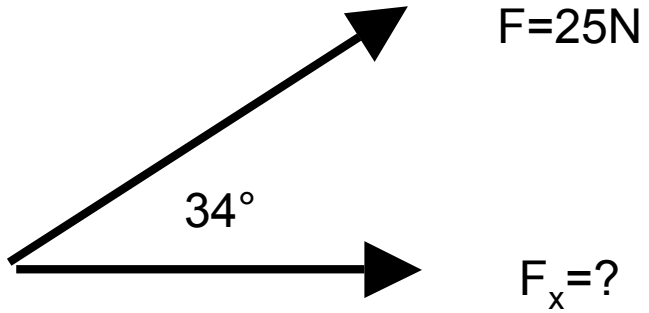
Sample Problem
(work done by a force at a different angle)

Fido is pulled backwards by his owner with a force of 25 N in the leash at and angle of 34°. Fido is pulled back a distance of 1.5 m. How much work was done by the owner?

Only the horizontal component of the force (F * cosine θ) causes a horizontal displacement.

Solution

- The component of force that lies along the same direction of motion is what does the work.
- Find the horizontal component.



Solution (continued)

- $F_x = F \cos \vartheta = 25\ N \cos (34°) = 20.7\ N$
- Therefore: $W = F_x D = F \cos \vartheta\ D$
- $W = 20.7\ N \times 1.5\ m =$ **31.1 Joules**
- So, from now on, the more accurate formula to find work is $W = F \cos \vartheta\ D$
- Where ϑ is the angle between the force vector and the displacement vector.

Practice!

Example as class: page 163 #2

Individual practice: Page 162 #’s 1-4

Answer questions 1 and 2 on page 163